Total Prosthetic Replacement for Aortic Valvular Disease

D. G. MULDER, M.D., and A. A. KATTUS, M.D., Los Angeles

• At the hospital of the University of California, Los Angeles, patients with acquired aortic valvular disease have been treated in the past by debridement of the obstructing calcifications or partial replacement of the valve with prosthetic cusps or a combination of these techniques. In a long-term evaluation of these patients, such methods were shown to be inadequate in most instances. We now recommend total valve replacement with the Starr-Edwards prosthetic valve in all patients with calcific aortic stenosis and for those with aortic insufficiency due to irreparable valvular lesions. The selection of patients, the operative technique, and the results thus far in nine patients are presented.

DURING THE PAST four and a half years, patients with acquired aortic stenosis have been treated at the hospital of the University of California, Los Angeles, by debriding the aortic valve of the obstructing calcifications, or by partially replacing the valve with prosthetic cusps, or by using a combination of these techniques.[3] In a recent evaluation of the long-term results in these patients it was observed that the stenotic process invariably recurred. Subtotal replacement of the insufficient aortic valve likewise was frequently inadequate. Therefore, a more radical approach to these lesions seemed justifiable.

Patients with calcific aortic stenosis and those with aortic insufficiency with irreparable valvular lesions are now treated by total replacement with the Starr-Edwards prosthesis.[3,5] This report concerns our experience with nine patients in whom total aortic valve replacement was performed.

SELECTION OF PATIENTS

Aortic Stenosis

Any patient with clinical findings suggestive of aortic stenosis, especially if symptoms of angina, syncope or congestive heart failure were present, had a thorough cardiac evaluation. Left ventricular hypertrophy on electrocardiogram strongly suggested an obstructive lesion in these cases. Roentgenograms of the chest frequently showed some enlargement of the cardiac silhouette but the abnormality was seldom striking. Calcification in the aortic valve was frequently seen. Measurement of simultaneous pressures in the left ventricle and systemic artery to determine the gradient across the aortic valve was done in virtually all suspect cases, to confirm the diagnosis and to assess the severity of the condition. A pressure differential across the valve of 50 mm of mercury or more represents a significant obstruction, and with few exceptions was considered indication for operation. Because acute left ventricular failure and sudden death occurs frequently in such patients, surgical relief of the obstruction was undertaken promptly.

Aortic Insufficiency

In contrast, patients with aortic insufficiency may tolerate the lesion for many years. Because of the dissatisfaction with prosthetic devices previously available, a conservative attitude prevailed toward operative intervention. Nevertheless, surgical repair was undertaken in patients with repeated bouts of congestive heart failure or rapidly progressive cardiomegaly, since in its later stages this lesion is refractory to conservative therapy. Since experience with the Starr valve in the aortic position has been eminently satisfactory, a more aggressive attitude seemed justified.[4] With few exceptions, operation was recommended if angina was developing or the patient had early symptoms of congestive heart failure or progressive cardiomegaly. For asymptomatic patients the decision depended upon other factors, including electrocardiographic and roentgenologic findings. Left heart catheterization and injection of radiopaque dye into the aortic root were performed only in special circumstances, since in most cases these procedures add very little essential information. Such studies are indicated if the patient is suspected of having coronary artery or coexistent mitral valve disease.

OPERATIVE TECHNIQUE

Ordinarily a median sternotomy incision was used, but if there was an associated mitral valve lesion, right lateral or bilateral anterior thoracotomy was employed. The patient was cooled on extracorporeal circulation to 30° C and the aortic valve was exposed through a transverse aortotomy. Myocardial protection was afforded by continuous perfusion of the coronary arteries. The deformed valve cusps were totally excised with only a 2 mm stub of tissue left at the base. It was frequently necessary

From the University of California, Los Angeles, Departments of Surgery and Medicine, The Center for the Health Sciences, Los Angeles.

Submitted September 23, 1963.

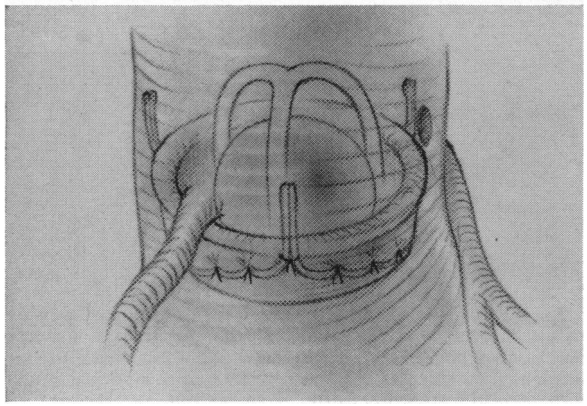

Figure 1.—After excision of the valve, the prosthetic device is seated in the subcoronary position by suturing to the cusp remnant.

TABLE 1.—*Summary of Results in Nine Patients With Aortic Stenosis (AS), Aortic Insufficiency (AI) or Both, Who Had Total Aortic Valve Replacement*

Patient	Lesion	Cardiac Class	Results	
			Condition	Post-Op (Months)
52 w ♂	AS, AI	III	Good	4
55 w ♂	AS, AI	III	Good	3½
57 w ♀	AS, AI	III	Good	3
55 w ♂	AS	III	Good	3
50 w ♂	AS, AI	III	Good	2½
44 w ♀	AI	IV	Good	2
43 w ♂	AS	II	Died (4 days)	....
34 w ♂	AS*	II	Good	1
29 c ♂	AI	III	Good	1

*Re-operation (debridement performed initially with complete return of gradient three years later).

to debride calcific encrustations from the adjacent aortic wall or from the region of the coronary ostia.

A valve of proper size was then selected by testing the orifice in the aortic root with graded plastic sizers. The prosthetic valve was then guided into position on 12 to 15 sutures of 1-0 silk that had been placed for the purpose (20 to 25 sutures of Tev-Dek* are now used). Suture placement does not follow the scalloped margin of the cusp remnant all the way to the apex of the commissure, since this would result in occlusion of the coronary ostia by the prosthesis placed at this level (Figure 1). The perfusion cannulae were removed as the aortotomy was closed with a continuous everting mattress suture of 3-0 silk reinforced by an over-and-over suture of the same material. A left ventricular vent, inserted through a stab wound in the cardiac apex, was always used to prevent overdistention of the left ventricle during cooling and to relieve the heart of much of its work load during resuscitation and rewarming. Once the valve was in place, care was taken not to exert excessive negative pressure on the vent, since this has been known to cause the ball to stick in the closed position. When the patient had been rewarmed and strong cardiac action had returned, the vent was removed and bypass was discontinued.

*Deknatel.

RESULTS

Nine patients at the hospital of the University of California, Los Angeles have undergone total aortic valve replacement with the Starr-Edwards ball valve (Table 1). Two of them had pure aortic insuffi-

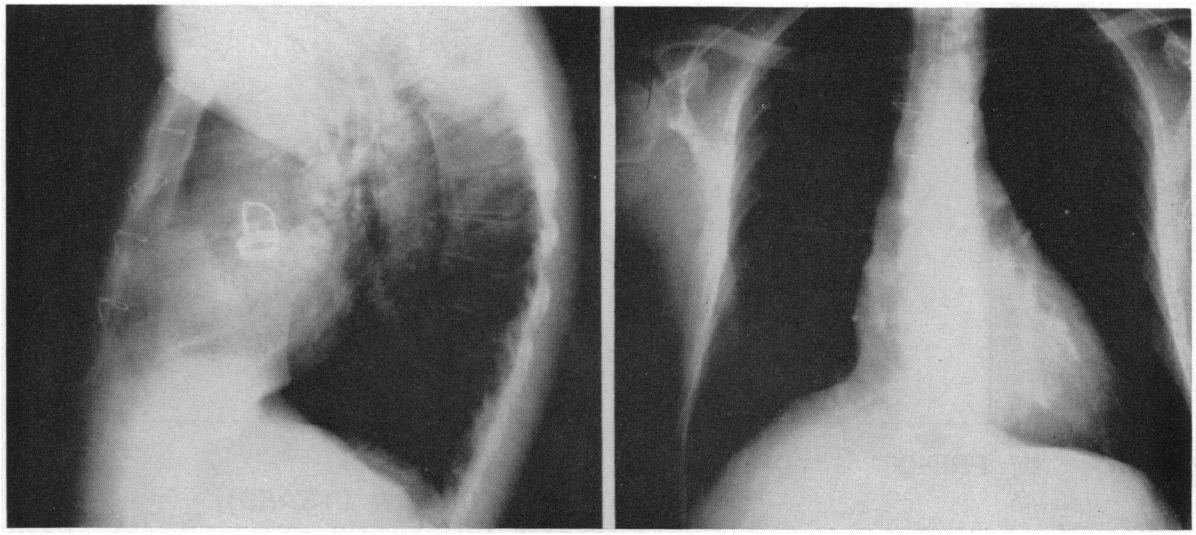

Figure 2.—Posterior-anterior and lateral chest roentgenogram, two months after operation, in a patient with calcific aortic stenosis.

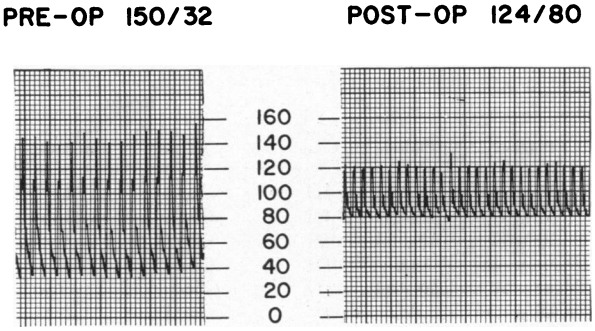

Figure 3.—Showing wide pulse pressure (mm of mercury) typical of aortic insufficiency, corrected by total valve replacement.

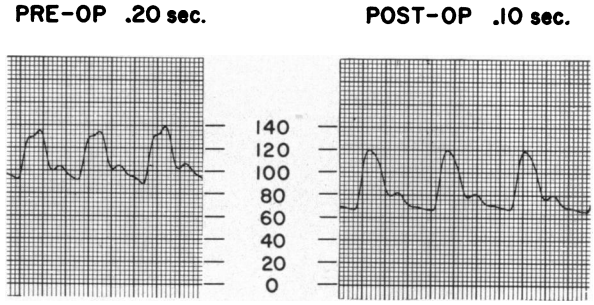

Figure 4.—Total replacement with the Starr-Edwards valve affords complete relief of the obstructive process and reurns contour of the arterial pulse tracing (mm of mercury) to normal. The rise time before operation was 0.20 second; after operation, 0.10 second.

ciency, one with multiple large cusp fenestrations presumably due to a bacterial endocarditis. Four had predominant aortic stenosis with significant associated aortic insufficiency. Three patients had pure aortic stenosis (Figure 2). One death occurred four days postoperatively from an unexplained progressive low-output syndrome. Inability to perfuse the right coronary artery during the repair may have been a factor. There have been no late deaths. However, in one patient bacterial endocarditis which was successfully treated, developed four weeks postoperatively. There were no embolisms, although no anticoagulants were used.

DISCUSSION

As was previously noted, in a recent evaluation of the long-term results of the treatment of acquired calcific aortic stenosis by the debridement technique or subtotal replacement with prosthetic cusps it was noted that the obstructive process recurred in all cases.[2] Eleven patients were restudied by left heart catheterization 13 to 48 months postoperatively. Seven patients had undergone a debridement procedure with virtual abolishment of the gradient across the valve (Chart 1). Four patients had had one cusp excised and a prosthetic cusp inserted, as well as debridement of additional areas of calcifica-

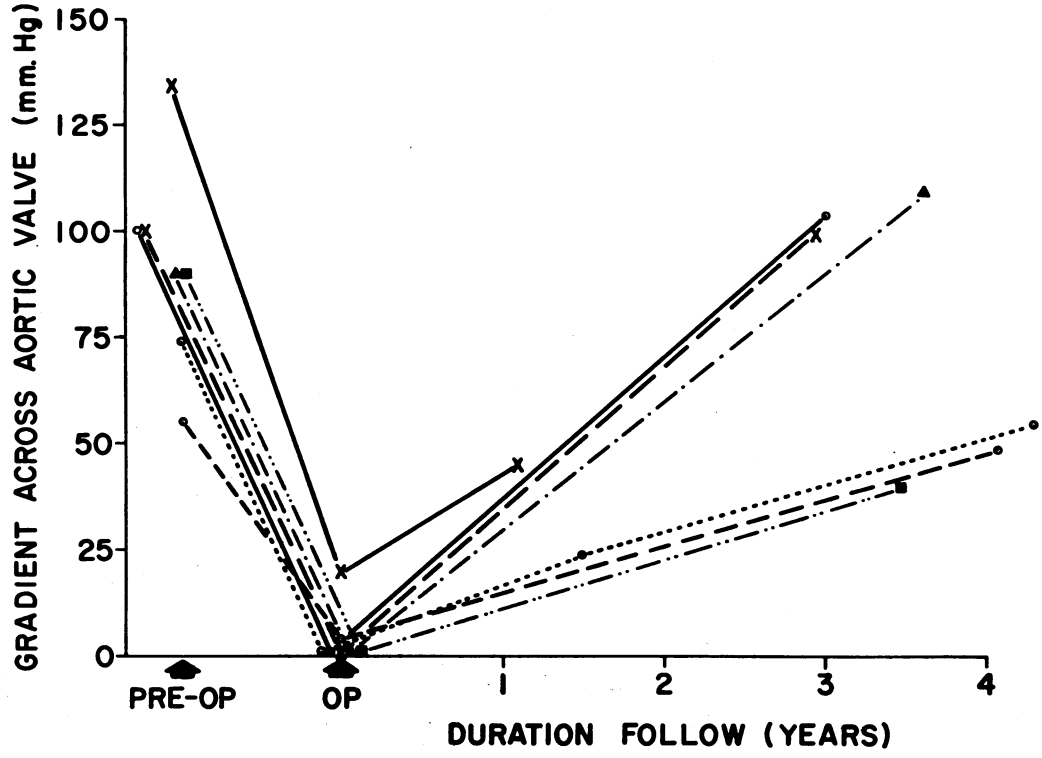

Chart 1.—Left heart catheterization results in seven patients who had undergone a debridement procedure for calcific aortic stenosis. Despite an excellent initial result, the obstructive process recurred to a significant degree in all patients within three years. (Reprinted with permission from J. Thor. & Cardiovasc. Surg. 46:468, 1963.)

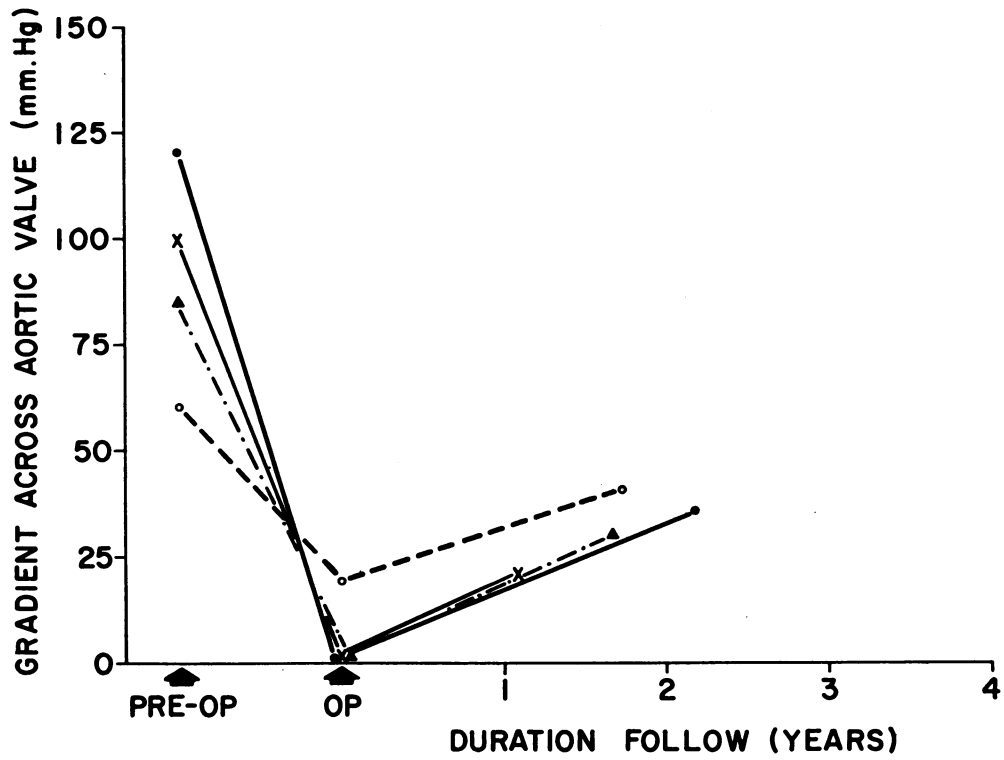

Chart 2.—Left heart catheterization in four patients who had undergone cusp replacement for calcific aortic stenosis. A similar trend toward restenosis had occurred within two years after operation. (Reprinted with permission from J. Thor. Cardiovasc. Surg. 46:468, 1963.)

tion (Chart 2). In each group, significant obstruction had recurred two to three years after operation nor was partial replacement with a Teflon cusp uniformly successful, because of stiffening, loss of pliability or even fracture of the fabric.[1]

Although patients with the Starr-Edwards valve have been followed a relatively short time, the accumulated experience to date has been quite gratifying. Decided improvement in hemodynamics has occurred in each instance. The wide pulse pressure typical of patients with aortic insufficiency has reverted to normal (Figure 3). Complete abolishment of aortic valve gradient and return of the arterial pulse contour to normal have been achieved in those patients with aortic stenosis (Figure 4). However, observations of these patients over a longer period will be necessary for a sound evaluation of the use of the Starr-Edwards valve in the treatment of acquired aortic valvular disease.

Departments of Surgery and Medicine, U.C.L.A. School of Medicine, The Center for the Health Sciences, Los Angeles, California 90024 (Mulder).

ADDENDUM: Since this report was submitted 21 additional patients with aortic valvular disease have undergone valve replacement. There have been two operative and seven late deaths in the 30 patients now followed up to one year. Three deaths were due to bacterial endocarditis, one to progressive congestive heart failure, one to massive cerebral embolus, and two are unexplained, presumably related to an acute arrhythmia.

REFERENCES

1. Bjork, V. O., Cullhed, I., and Lodin, H.: Aortic valve prosthesis (Teflon): Two year follow-up, J. Thor. Surg., 45:635, 1963.

2. Mulder, D. G., Kattus, A. A., Fonkalsrud, E. W., and Longmire, W. P., Jr.: The surgical treatment of acquired aortic stenosis, J. Thor. Surg., 46:468, 1963.

3. Mulder, D. G., Kattus, A. A., and Longmire, W. P., Jr.: The treatment of acquired aortic stenosis by valvuloplasty, J. Thor. Surg., 40:731, 1960.

4. Starr, A.: Personal communication.

5. Starr, A., and Edwards, M. L.: Mitral replacement: Clinical experience with a ball-valve prosthesis, Ann. Surg., 154:726, 1961.

6. Starr, A.: Discussion of a paper by McGoon, D. C., Mankin, H. T., and Kirklin, J. W.: Results of open-heart operation for acquired aortic valve disease, J. Thor. Surg., 45:47, 1963.